ANGLER HARVEST SURVEY

LAKE LABERGE 2007

Prepared by:

Nathan Millar, Aaron Foos, Oliver Barker, and Lars Jessup

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Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
E-mail: environmentyukon@gov.yk.ca

Also available online at www.env.gov.yk.ca
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Key Findings

- Anglers spent an estimated 6,705 hours angling on Lake Laberge in the summer of 2007. This was 0.33 hours per hectare, slightly higher than average for very large Yukon lakes.
- Approximately 773 kg of lake trout were harvested (including incidental mortality from catch and release) by recreational anglers over the summer, which was substantially higher than in 2002.
- We estimate that the lake trout harvest was within predicted sustainable levels to maintain fishing quality on Lake Laberge, so long as unquantified harvests (open water harvest outside of the survey period, First Nation subsistence harvest, and ice fishing harvest) are less than 547 kg.
- Eighty-one percent of lake trout caught were retained. This was above Yukon averages.
- Angler success, as measured by the number of lake trout caught per hour of angling, declined from average in 2002 to 50% of that in 2007. The reason for the decline is unclear.
- None of our findings pointed strongly to a decline or to an improvement in the Lake Laberge fishery or fish population. We recommend regular monitoring of this important fishery.

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Introduction

We conduct angler harvest surveys, also called creel surveys, on a number of Yukon recreational fisheries each year. We use these surveys, together with other fish and fishery-related assessments, to find out if the harvest of fish from the lake is sustainable. Environment Yukon tries to conduct angler harvest surveys on key fisheries either every 5 years or according to angler patterns and management concerns. The results of the surveys directly contribute to management decisions that make sure fisheries are sustainable over the long term.

Lake Laberge is located in the south central Yukon within the traditional territories of the Ta'an Kwächän and Kwanlin Dün First Nations. It is a large (201 km^2), deep (mean depth 54 m) lake with its southern end located about 25 km north of the City of Whitehorse. Lake Laberge is the last of several large southern lakes that comprise the headwaters of the Yukon River system. There are populations of lake trout, lake whitefish, broad whitefish, least cisco, round whitefish, longnose sucker, burbot, northern pike, and Arctic grayling in the lake (Thompson 1996).

Access is limited to the southern part of the lake where the North Klondike Highway roughly parallels the western shore. There are several side roads providing access to clusters of country residential lots and cottages scattered along the southern and western shorelines. There is a government campground and boat launch within the Deep Creek subdivision, near the mouth of Deep Creek. This location is somewhat sheltered in the large bay behind Richtofen Island. The public boat launch at this campground is the only maintained launching point on the lake and is where a vast majority of visitors to the lake gain access.

We assessed the angler harvest once before, in 2002. Lake Laberge was chosen for a follow up survey in 2007 because of its importance and high level of use.

The 2007 survey was done to:

- determine how much time anglers spent fishing (effort);
- understand the fishery's characteristics and patterns of use;
- measure the success rate of anglers;
- compare the level of harvest to the productive capacity of the lake;
- record biological information on harvested fish;
- provide anglers with information about regulations; and
- establish a fisheries management presence.

Harvest Regulations

Lake Laberge continues to be managed under general catch and possession angling regulations. These regulations are the most liberal regulations and provide some limited protection to large fish by allowing the retention of only one large fish of each species. The catch limit for lake trout is 3 fish per day and only one may be longer than 65 cm. The possession limit is 6 fish. The catch limit for Arctic grayling is 5 fish per day and only one may be longer than 40 cm. The possession limit is 10 fish. The catch limit for northern pike is 5 fish per day and only one over 75 cm can be kept. The possession limit is 10 fish. General catch and possession limits also apply to the other species.

The regulation history for Lake Laberge is detailed in Appendix 1.

Methods

Survey

In 1990 the Yukon Government adopted survey methodology developed by the Ontario Ministry of Natural Resources (Lester and Trippel 1985). A field worker conducts face-to-face interviews with anglers on selected sample days throughout the summer. The worker asks a standard set of questions about the social and biological aspects of the fishery. Data gathered include:

- How much time did anglers spend fishing?
- What fishing methods did anglers use?
- How did anglers fish (boat, shore, etc.)?
- Were anglers guided?
- Where were anglers from?
- What type of visitor were anglers (day users, campers, etc.)?
- What kinds of fish were anglers trying to catch?
- How many fish did anglers catch?
- How many fish did anglers release?

Any other information offered by anglers about their fishing experience is also recorded.

The field worker also collects biological data on the catch of cooperative anglers. Biological data gathered include: length (mm), mass (g), sex, maturity, an aging structure, as well as the collection of stomachs for content analysis in the lab. Any other information about general health and condition of the fish is recorded by the field worker (e.g., abnormalities, disease, lesions).

The field worker subjectively assesses the weather's effect on fishing over the entire sample day (no possible adverse effect, possible adverse effect, definite adverse effect).

The timing of the survey depends on management objectives, key species, and the nature of the fishery. It typically runs from ice out in the spring until either just after Labour Day or the end of September. The goal is to sample at least 20% of the total survey days. The survey is subdivided into several seasonal periods (usually 3 or 4) to better understand changes in angler activity. These periods are further divided into weekends and weekdays. Sample days are allocated to each period while considering both a higher weighting for those periods with the higher projected angler use and a minimum number of samples for each period.

Sample days are 14 hours long, 8:00AM to 10:00PM. On sample days, the field worker interviews all willing anglers. The field worker also records anglers who are observed but not interviewed.

Analysis

When the survey is finished, we enter the data into a computer program called CREESYS developed by the Ontario Ministry of Natural Resources (Lester and Trippel 1985). We determine the age of sampled fish by counting growth rings on the otolith. Diet is determined by examining the stomach contents.

Lake Productivity

The productivity of a lake determines the amount of fish produced annually and can guide how much harvest can be sustained. Estimates of lake productivity are calculated using average lake depth, the concentration of total dissolved solids, and the average annual air temperature at the lake. Ryder's morphoedaphic index (1974) is used and incorporated into Schlesinger and Regier's equation (1982) for calculation of maximum sustained yield (MSY) for all species. Calculation of MSY for lake trout assumes a biomass of 30% lake trout; where appropriate this may be replaced by the most recent survey data. Following O'Connor (1982) and others, 15% of MSY provides an "optimum" sustained yield (OSY), which maintains high quality fisheries on light to moderately fished lakes.

2007 Lake Laberge Survey

The survey began June 1 (ice went out May 28) and concluded September 15, 2007.

We used an access survey methodology, meaning the field worker was stationed at the Lake Laberge campground and boat launch near Deep Creek (Figure 1) for the entire sample day and interviewed angling parties at the end

of their fishing trip. Previous surveys and local knowledge indicated that most anglers access Lake Laberge from this location. Some angling activity originates elsewhere, such as at homes and cabins along the shore and river travellers passing though or accessing the lake via the Yukon River. The number of anglers at other locations is thought to be small, based on Conservation Officer patrols and anecdotal information.

The survey period was partitioned into 6 time periods, weekends and weekdays in June, July and August/September. Of the 107 day survey period, 28 days were sampled, resulting in a sampling effort of 26%.

We analyzed the data 2 ways. In the first, we combined data across all 6 time periods, and in the second part we compared results between time periods. All data were analyzed at the group level.

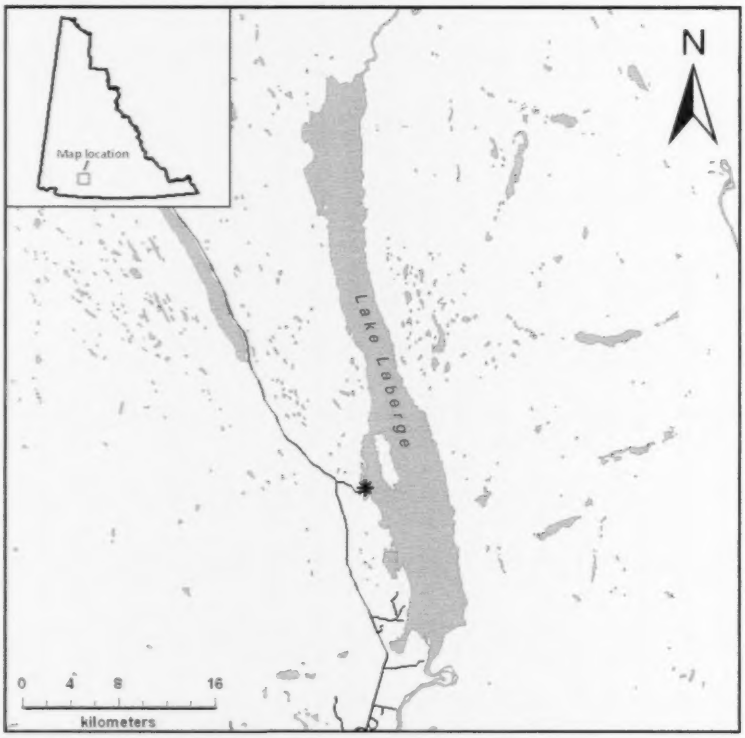

Figure 1. Lake Laberge, showing location of 2007 Angler Harvest Survey (*).

Results of the 2007 Survey

Effort

Anglers spent a total of 6,706 hours fishing on Lake Laberge over the 2007 survey period for an average of 0.33 hours per hectare. This was above average for very large Yukon lakes. Altogether, 1,632 anglers in 770 parties fished on Laberge for an average of 4.1 hours per angler. Fishing occurred for an average of 62.7 angler hours per day over the entire survey.

Fishing Methods

Trolling was by far the most popular method of fishing, followed by combinations of methods and then spin casting (Table 1).

Table 1. Fishing methods, Lake Laberge 2007.

Method of Fishing	Percent of Parties
Still	
Jig	
Drift	
Troll	78%
Spin Cast	9%
Fly Cast	
Other or Combination	13%

Methods of Access

Most anglers (93%) accessed the lake by motorboats, while a few anglers (7%) accessed the lake from shore. Canoes were also used but were not represented in the sample.

Guided Anglers

Nine percent of anglers were formally guided.

Angler Origin

Most anglers were from Whitehorse (Table 2). There were a small percentage of local fishers and a few American anglers.

Table 2. Angler origin, Lake Laberge 2007.

Origin	Percent of Parties
Local	3%
Whitehorse	94%
Yukon	
Canada	
U.S.	3%
Other	

Visitor Type

Most anglers were day users (Table 3). Some anglers stayed in the government campground and there were a few anglers who camped on crown land.

Table 3. Angler visitor type, Lake Laberge 2007.

User Type	Percent of Parties
Day Users	73%
Camper – territorial campground	21%
Camper – crown land	3%
Camper – private campground	
Unknown	3%

Weather

The field worker's subjective assessment of weather effects on angling activity indicated that weather had little effect on angling activity (Table 4).

Table 4. Sample day weather, Lake Laberge 2007.

Did Weather Affect Angling?	Percent of Parties
No possible adverse effect	63%
Possible adverse effect	31%
Definite adverse effect	6%

Targeted Species

Anglers targeting a particular species, especially Arctic grayling, were more successful than those that did not (Table 5). Although only 8% of anglers specifically targeted Arctic grayling, those anglers were responsible for 99% of the Arctic grayling catch and 100% of the Arctic grayling harvest. Eighty-nine percent of anglers targeted lake trout and were responsible for 100% of the catch and 100% of harvest. Twenty-two percent of anglers targeted northern pike and they were responsible for 100% of the catch and harvest.

Table 5. Catch and harvest by anglers targeting specific species.

Species	Percent of Parties	Percent of Total Catch	Percent of Total Harvest
Lake trout	89%	100%	100%
Northern pike	22%	100%	100%
Arctic grayling	8%	99%	100%

Catch and Harvest

Arctic grayling were the most heavily caught and harvested species with a moderate retention rate (Table 6). Most of the lake trout caught were kept (retention rate above Yukon average). A small number of lake whitefish, inconnu, and pike were caught.

Table 6. Angler catch and harvest, Lake Laberge 2007.

Species	# Caught	# Kept	Retention Rate
Arctic grayling	1283	342	27%
Lake trout	384	312	81%
Inconnu	24	0	0%
Lake whitefish	24	0	0%
Northern pike	7	7	100%

Estimated angler success rates, calculated over the entire survey as numbers of fish caught per hour of angling effort (CPUE), is presented for all anglers (regardless of target species) and species anglers (those targeting a specific species) in Table 7. As expected, anglers targeting a specific species were more successful than general anglers for all species, but particularly for Arctic grayling, as they were targeted in prime habitats in which they

aggregate, such as creek inflows. Anglers targeting Arctic grayling had excellent results. Lake trout results for both categories were below Yukon averages. Success rates for northern pike, inconnu, and lake whitefish were all low, but they were not (or rarely) specifically angled for and rarely caught.

Table 7. Estimated catch per unit of effort (fish/hour), Lake Laberge 2007.

Species	All Anglers CPUE	Species Anglers CPUE
Arctic grayling	0.19	1.00
Lake trout	0.06	0.07
Inconnu	0.004	n/a
Lake whitefish	0.004	n/a
Northern pike	0.001	0.008

Breakdown of 2007 results by period is presented in Appendix 2.

Comparison with Previous Surveys

We have surveyed the angler harvest on Lake Laberge only once before, in 2002. That survey used a similar method and design and is directly comparable with the 2007 survey. The only difference was that the 2002 survey ended September 4, while the 2007 survey continued to September 15.

Effort

For unknown reasons, the estimated summer open water angler effort increased dramatically from 1,850 in 2002 to 6,706 in 2007. Current effort is now slightly above average for lakes of this size.

Fishing Methods

Fishing methods remained similar between surveys (Table 8).

Table 8. Fishing methods (percent of parties) Lake Laberge, 2007, and 2002.

Fishing Method	2007	2002
Still		
Jig		
Drift		
Troll	78%	85%
Spin Cast	9%	5%
Fly Cast		
Other or Combination	13%	9%

Methods of Access

In both years, most anglers used motorboats to access the fishery, with a slight increase from 1% to 7% between 2002 and 2007 for shore anglers (Table 9).

Table 9. Methods of access (percent of parties), Lake Laberge 2007, and 2002.

Method of Access	2007	2002
Canoe		2%
Rowboat		
Motorboat	93%	97%
Shore	7%	1%
Other		

Guided Anglers

Formally guided parties comprised 9% of anglers in 2007, while none were observed in 2002.

Angler Origin

Whitehorse-origin anglers have been dominant in all years and have increased since 2002 (Table 10).

Table 10. Origin of anglers (percent of parties) Lake Laberge 2007, and 2002.

Origin	2007	2002
Local	3%	10%
Whitehorse	94%	85%
Yukon		2%
Non-resident Canadians		3%
U.S.	3%	
Other		

Visitor Type

Day users were dominant in both years, followed by campground users (Table 11). There were a few Crown land campers in 2007 but none were observed in 2002.

Table 11. Visitor type (percent of parties), Lake Laberge 2007, and 2002.

Visitor Type	2007	2002
Day Users	73%	75%
Camper – territorial campground	21%	25%
Camper – Crown land	3%	
Camper – private campground		
Unknown	3%	

Weather

The field worker's subjective assessment of weather effects on angling activity over the entire sample day indicates that weather was somewhat better in 2007 than in 2002 (Table 12).

Table 12. Weather effects on angling activity (percent of parties), Lake Laberge 2007, and 2002.

Did Weather Affect Angling?	2007	2002
No possible adverse effect	63%	43%
Possible adverse effect	31%	54%
Definite adverse effect	6%	3%

Catch and Harvest

Arctic grayling catch and harvest increased substantially between surveys (Table 13). Lake trout catch and harvest estimates were also much higher in 2007 than they were in 2002. Anglers also kept a higher percentage of their catch. There were incidental catches of northern pike catches, inconnu, and lake whitefish.

Table 13. Estimated number of fish caught, fish kept and the retention rate, Lake Laberge 2007, and 2002.

Species	Retention	2007	2002
Arctic grayling	Caught	1,283	10
	Kept	343	10
	Released	940	0
	% Kept	27%	100%
Lake trout	Caught	384	239
	Kept	312	161
	Released	72	78
	% Kept	81%	67%
Northern pike	Caught	7	8
	Kept	7	8
	Released	0	0
	% Kept	100%	100%
Inconnu	Caught	24	
	Kept	0	
	Released	24	
	% Kept	0	
Lake whitefish	Caught	24	3
	Kept	0	3
	Released	24	0
	% Kept	0	100%

Estimated CPUE (number of fish per angler hour) over the entire survey can reflect changes in the fishery because it incorporates effort and catch. Dramatic decreases in CPUE for a particular species could indicate problems in terms of the health or status of the fish species in question. However, relying on CPUE of anglers alone is not recommended – see the section entitled "Invisible Collapse" in the *Status of Yukon Fisheries 2010* (Environment Yukon 2010) – anglers are very good at finding fish even when the population is in decline.

Lake trout CPUE declined dramatically between surveys (Table 14). In 2002, results were average for Yukon, but dropped by 50% in 2007. It is unclear why there was such a precipitous decline.

Table 14. Estimated catch per unit of effort (fish/hour), Lake Laberge 2007, and 2002.

Species	2007	2002
Lake trout	0.06	0.13
Inconnu	0.004	
Lake whitefish	0.004	0.002
Arctic grayling	0.19	0.005
Northern pike	0.001	0.004

The CPUE for species other than lake trout was very low in both survey years, other than for Arctic grayling which showed a substantial increase in 2007. This was likely because more anglers specifically targeted Arctic grayling in 2007, whereas they were incidental in 2002.

2007 Biological Data

We sampled 25 lake trout for fork length (mean 563 mm) and weight (mean 2,271 g). These fish had a mean condition factor of 1.27 which is very good for lake trout in Yukon and indicates "fat" fish (condition factor is the relationship between length and weight). The sex ratio in the sample was skewed towards males with 0.56 females per male. Lake trout were harvested across a range of size classes from 473 to 810 mm, although sizes over 620 mm fork length (650 mm total length) are possibly underrepresented in the sample as regulation allows the retention of only one fish over this size (Figure 2).

We aged 15 of the sampled lake trout. These fish ranged from 8 to 32 years (Figure 3), but the sample size was too small to make robust conclusions about the age distribution of lake trout in Lake Laberge. Note that young fish (less than 5 years) are not vulnerable to angling gear and regulation limits the harvest of larger fish. These portions of the population are therefore under represented in the sample.

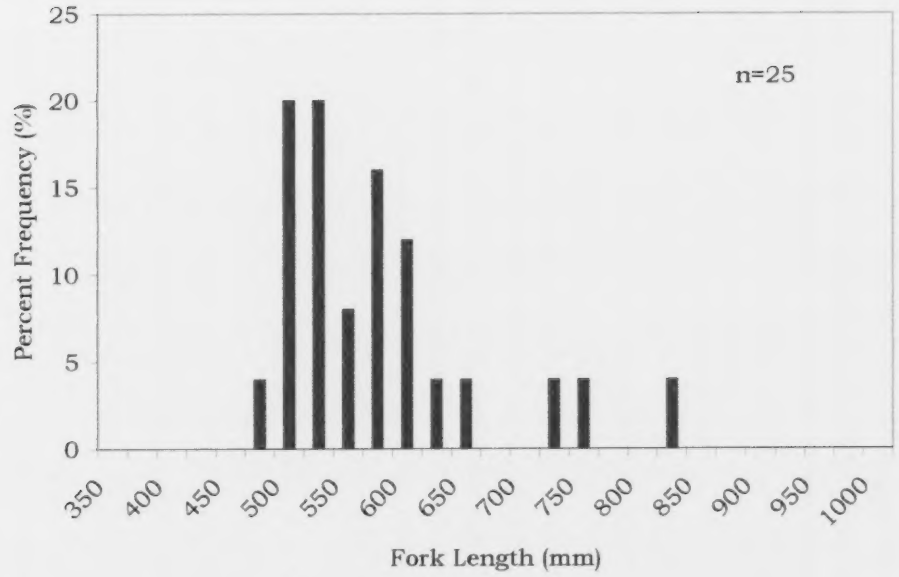

Figure 2. Fork lengths of lake trout caught by anglers.

Figure 3. Ages of lake trout caught by anglers.

We examined the stomachs of 16 lake trout. Of these, 5 were empty and the remaining 11 averaged 39% full. Fish were the most common diet item identified, comprising 92% of the lake trout diet (Table 15).

Table 15. Sampled lake trout stomach contents, Lake Laberge 2007.

Stomach Content	Percent Volume
Fish (unidentified)	84%
Unknown items	6%
Slimy sculpin	5%
Least cisco	2%
Ants	2%
Round whitefish	1%
Midges	
Stoneflies	Trace
Flies	

No other species were sampled for biological data over the survey.

Fishery Sustainability

Based on the productivity of the system, we estimate that Lake Laberge could sustain a total annual lake trout harvest of about 1,320 kg and still maintain a high quality fishery (total dissolved solids: 68 mg/L, mean annual air temperature: -2.0 °C, mean depth: 54.0 m; see Methods - *Lake Productivity*). Predictions of sustainable yield are imprecise, so we attempt to minimize risk and maintain fishery quality by using conservative estimates.

Anglers harvested 312 lake trout from Lake Laberge over the summer (Table 16). Total fish mortality (death) includes the unintentional mortality of any released fish. Catch and release, when done properly, has a minimal impact. Lake trout survival rates range from 93% for lightly handled fish to 76% for deep-hooked fish (YFWMB 1998). We used an average of 85% survival. For the 72 lake trout released in 2007, this results in an additional mortality of 12 fish for a total of 323 fish. Based on the average size of harvested fish, the weight of total lake trout mortality in the recreational fishery was 733 kg.

Fishing harvest and mortality in 2007 (773 kg) was lower than the OSY (1320 kg) as estimated from the potential productivity of the lake. We consider this to be a minimum harvest estimate, because additional harvests from the open water fishery outside the survey period, the ice fishery, and the First

Nations subsistence fishery were not included. A small ice fishery also occurs on Lake Laberge but it has never been formally monitored. Anecdotal information suggests that the fishery is focused on burbot and effort and harvest of lake trout are low. First Nations subsistence harvest also occurs on Lake Laberge and levels are not known. If these other sources of harvest are less than 547 kg, then the harvest of lake trout from Lake Laberge should be sustainable.

Table 16. Estimated summer lake trout harvest by anglers, Lake Laberge 2007, and 2002.

Lake Trout Harvest	2007	2002
Lake trout harvested	312	161
Lake trout released	72	78
Lake trout mortality from catch and release	11	12
Total lake trout mortality	323	173
Mean weight of lake trout	2.27 kg	2.74 kg
Weight of total lake trout mortality	733 kg	474 kg

Other sources of data do not point strongly to conclusions about population health. The large jump in angling pressure from 2002 to 2007 may be concerning. However, we cannot tell if this increase is a trend (i.e., more anglers each year) or is part of the year-to-year variation (e.g., better weather in 2007 may have played a role). Interestingly, this increased effort (260% increase) did not lead to an equivalent increase in catch (60% increase) or harvest (112% increase), mostly because anglers had a harder time catching trout in 2007. Because we saw such a vastly different effort in 2007, it is hard to conclude that poor angler success came about because of a smaller lake trout population. It may reflect more on the increase in casual anglers in 2007 who were overall less successful. Not enough biological data were collected to draw meaningful conclusions. Recent fish population assessments did not find decreases in the population but were limited in their ability to detect change (Jessup 2011).

We did not find conclusive evidence that the fishery in Lake Laberge is either improving or declining. We recommend that another angler harvest survey be carried out so that trends can be confirmed or denied. We recommend that other sources of harvest are quantified so that total harvest can be estimated.

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APPENDIX 1. Lake Laberge angling regulation changes 1989 to 2007.

Year	Species	Catch limit	Possession limit	Size restrictions
1989/90*			General Regulations	
	Lake trout	3	6	Only one fish over 80 cm
	Arctic grayling	5	10	none
	Northern pike	5	10	none
	Whitefish	5	10	none
1991/92			General Regulations	
	Lake trout	3	6	Only one fish over 65 cm
	Arctic grayling	5	10	Only one fish over 40 cm
	Northern pike	5	10	Only one fish over 75 cm
	Whitefish	5	10	none

* Yukon Government obtained responsibility for freshwater fisheries management from the federal government in 1989.

APPENDIX 2. 2007 Results: Comparisons between periods

Effort

Mean daily angler effort on weekends was very high throughout the summer, but highest in July (Figure 2.1). Weekday effort was lowest in June, and peaked in July.

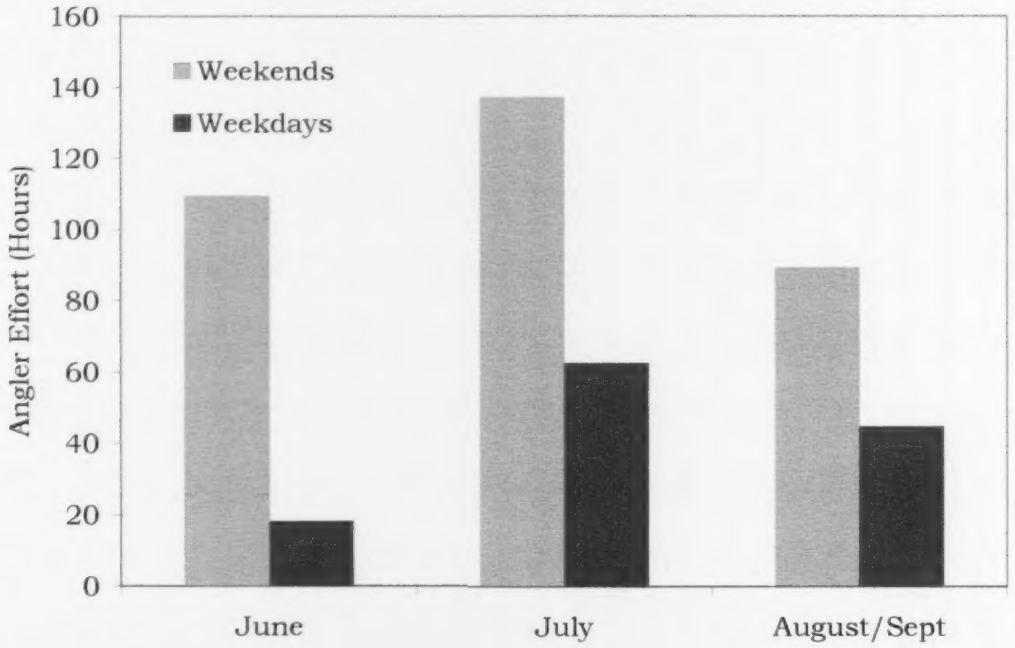

Figure 2. 1. Estimated angler effort per day.

Fishing Methods

Fishing methods were relatively consistent across all periods other than an anglers using combinations of methods on June and August/September weekends.

Guided Anglers

Guided parties were most active on June weekends and both August/September periods. They were not seen on June weekdays or July weekends.

Angler Origin

Whitehorse was the most common origin of angling parties in all periods. Local anglers were observed only in June periods and American anglers were observed only in June periods and August/September weekends.

Visitor Type

Visitor type was consistent over the summer with most government campground users present on weekends. Crown land campers were seen only on weekends in June and July.

Weather

The influence of weather on angling activity was not analyzed by period.

Catch

Lake trout CPUE was poor and variable over the summer. June and July weekdays showed the highest results, likely due to more experienced anglers fishing during the week (Table 2.1). Arctic grayling were mostly angled for on weekends. CPUE was low in most periods, but high on August/September weekends. Northern pike were angled for in most periods, but CPUE was extremely low. Lake whitefish and inconnu were only incidentally captured on August/September weekends with very low CPUE (Table 2.1).

Catch per unit effort patterns for lake trout are consistent with typical Yukon summer patterns. Success is highest in the spring following ice out and then drops as water temperatures warm. Often there are fall increases related to onset of spawning movements and cooling water temperatures. These fluctuations were not dramatic.

Table 2.1. Estimated catch per unit of effort (fish/hour) by period.

Period	Lake Trout	Lake Whitefish & Inconnu	Arctic Grayling	Northern Pike
June weekends	0.05		0.19	0.00
June weekdays	0.16			0.00
July weekends	0.04		0.00	0.00
July weekdays	0.13			
August/September weekends	0.03		0.11	0.005
August/September weekdays	0.00	0.02	0.69	